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DETERMINATION OF BIOFOAM AWARENESS OF STUDENTS IN CIVIL DEFENSE FIREFIGHTING AND EMERGENCY AND DISASTER MANAGEMENT PROGRAMS

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ABSTRACT

Objective: The aim of this study was to determine the level of awareness of biological foam among students enrolled in civil defense and firefighting and emergency and disaster management programs at four universities in the Eastern Black Sea region.

Materials and Methods: The study population consisted of students enrolled in these programs during the 2022-2023 academic year. No specific sampling method was used; an attempt was made to reach the entire population and a total of 260 respondents were interviewed. The data for the study was collected using a questionnaire that included socio-demographic characteristics, knowledge about fire, disasters and firefighting, attitudes towards exercises and a Biological Foam Awareness Scale (BFAS) questionnaire developed based on a literature review. Frequency and t-tests were used to statistically analyze the data.

Results: The research findings indicate that biological foam awareness is moderate among students enrolled in civil defense and firefighting and emergency and disaster management programs at the four identified universities.

Conclusion: Examination of the results of the study revealed that awareness of biological foam is inadequate. Therefore, it is recommended that efforts and activities to increase the awareness and use of biological foam be implemented, targeting both students in existing degree programs and individuals working in firefighting.

Keywords: Combustion, Fire, Suppression, Foam, Biological Foam

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Çalışma için Trabzon Üniversitesi Sosyal ve Beşeri Bilimler Bilimsel Araştırma ve Yayın Etik Kurulu'ndan izin (22.07.2022 tarih ve 2022-7/2.6 sayılı yazı) alınmıştır.

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SİVİL SAVUNMA İTFAİYECİLİK VE ACİL DURUM AFET YÖNETİMİ PROGRAMLARINDAKİ ÖĞRENCİLERİN BİYOLOJİK KÖPÜK FARKINDALIKLARININ BELİRLENMESİ

ÖZ

Amaç: Bu araştırma, Doğu Karadeniz bölgesinde bulunan dört üniversitede Sivil Savunma ve İtfaiyecilik ile Acil Durum ve Afet Yönetimi Programlarına devam eden öğrencilerin biyolojik köpük farkındalığı düzeylerini değerlendirmek amacıyla yapılmıştır.

Gereç ve Yöntemler: Araştırmanın evrenini 2022-2023 eğitim-öğretim yılında söz konusu programlarda öğrenim gören öğrenciler oluşturmuştur. Örneklem yöntemi olarak herhangi bir seçim yapılmamış, evrenin tamamına ulaşılmaya çalışılmış ve toplamda 260 kişiyle görüşülmüştür. Araştırmanın verileri, literatür taraması yapılarak oluşturulan sosyodemografik özellikler, yangın, afet ve yangın söndürme bilgisi ile tatbikatlara karşı tutumlarına ilişkin soruları içeren bir anket ile Biyolojik Köpük Farkındalık Ölçeği (BKFÖ) sorularını içeren bir anket aracılığıyla toplanmıştır. Verilerin istatistiksel analizinde frekans ve t-testi kullanılmıştır.

Bulgular: Araştırma sonuçlarına göre, belirlenen dört üniversitede Sivil Savunma ve İtfaiyecilik ile Acil Durum ve Afet Yönetimi Programlarında eğitim gören öğrencilerin biyolojik köpük farkındalık düzeylerinin orta düzeyde olduğu tespit edilmiştir.

Sonuç: Yapılan çalışmanın sonuçlarına bakıldığında biyolojik köpük farkındalığının yeterli düzeyde olmadığı görülmüştür. Bu nedenle hem mevcut programlarda okuyan öğrencilerin hem de itfaiye meslek grubunda çalışan kişilerin biyolojik köpük bilinirliği ve kullanımı konusundaki farkındalığı arttıracak çalışmaların ve faaliyetlerin yapılması önerilmektedir.

Anahtar Kelimeler: Yanma, Yangın, Söndürme, Köpük, Biyolojik Köpük,

INTRODUCTION

Combustion is he chemical process that results from the combination of combustible substances with heat and oxygen. The combustion process can also be described as the rapid oxidation of millions of vapour molecules (Sunar, 1983:585). Fire, on the other hand, is an uncontrolled development of combustion phenomena in time and space. The definitions of combustion and fire are important terms that should not be confused with each other. Just as not every combustion is a fire, every fire is necessarily the result of combustion. Combustion is a process in which a certain substance reacts with oxygen under the influence of heat, producing heat and light. This process is usually controlled and is used in a variety of situations to achieve desired results, such as lighting a stove at home or burning fuels used in industrial processes to generate energy. However, if the combustion process spreads uncontrollably or intensifies excessively, a fire is created. Fire is an uncontrolled and rapidly spreading combustion process

that often leads to severe damage, loss of life and destruction of the environment. Therefore, understanding and distinguishing between the concepts of fire and conflagration are crucial for the effective implementation of fire safety measures (Turhan et al., 2018:825-827). The categorization of fire as a disaster stems from its uncontrolled nature. Fire is an important issue to be categorized as a natural disaster. Fires can be caused by various factors, both natural and man-made. Natural causes include severe storms, lightning strikes, volcanic activity and heat waves, while man-made causes include neglected cigarette butts, sparks, misuse of electrical appliances and deliberate ignition of forest fires (Kılıç, 2018:8-10). Fires can have a negative impact on lives, the economy and the environment, leading to loss of life and property, damage to the ecosystem and economic losses. Therefore, continuous education campaigns should be carried out to control, prevent and mitigate the effects of fires. Firefighting and rescue teams should be effectively prepared and fire prevention measures strictly implemented. This approach is crucial to prevent fires from reaching catastrophic proportions and to ensure the safety of society (Uysal, 1997:97). Combustibles are substances that can produce flammable vapors or gasses or highly flammable liquids when exposed to heat. Most flammable substances contain elements such as carbon, hydrogen, sulfur and phosphorus. Flammable substances generally occur in nature in three different states: solid, liquid and gas. Water, foam, dry chemical powder, BC powder (sodium bicarbonate, potassium bicarbonate and potassium chloride), ABC powder, Class D fire extinguishing powder, carbon dioxide (CO2) and other extinguishing agents are commonly used substances in firefighting. Water is one of the most common extinguishing agents. It is particularly effective on solid fires and extinguishes fires by absorbing heat. Foam is an effective extinguishing agent used on liquid fires. It spreads over the surface, reduces the surface tension and prevents the fire from spreading. Dry chemical powders are generally effective on NBC fires. They suppress the fire by undergoing a chemical reaction during combustion and cutting off the oxygen. BC powders (sodium bicarbonate, potassium bicarbonate and potassium chloride) are particularly effective on Class B and C fires. They help to reduce the effects of fire and extinguish it. They help to extinguish solid, liquid and gaseous fires. ABC powders are generally used for fires of several classes. They are versatile and effective in extinguishing solid, liquid and gas fires. Class D fire extinguishing powders are intended for metal fires. They extinguish the fire by controlling the reaction of metal powders in particular. Carbon dioxide (CO_2) is mainly used in areas at risk of fire, e.g. in electrical installations and sensitive equipment. It suppresses the fire by eliminating the oxygen. These extinguishing agents have different effects depending on the type of fire, the size of the fire and the environmental conditions. Therefore, the correct selection and application of extinguishing agents is of great importance. Foam is an effective extinguishing agent used in firefighting because it is versatile. It prevents the fire from spreading and also

extinguishes it directly. In addition, foam extinguishing systems are often preferred for flammable liquid fires, as water may not be effective or may spread the fire. Foam can prevent flammable vapors from rising to the surface, bringing a dangerous situation under control before it gets worse. Therefore, foam is an important part of firefighting equipment and has a wide range of applications from various industrial facilities to firefighters (Kur, 2019:50-58). Foam is considered the most effective extinguishing agent for Class B fires. Studies have shown that only 10% of the water used on class A fires has an extinguishing effect, while the rest flows over combustible materials. Foam, on the other hand, adheres to the flammable material and extinguishes the fire. Foam can therefore also be used on class A fires without any problems. Foam prevents the formation of vapors during use and therefore does not restrict the visibility of the emergency services. Foam not only brings the fire under control quickly, but also prevents it from flaring up again, thus ensuring safety after the fire. Foam is particularly important when water alone is not enough. The foam prevents heat convection in the fire by cutting off contact with the air; the water inside evaporates and takes the place of the air. However, it should not be used on electrical fires as it is used with water. Foam has a wide range of applications in firefighting and is particularly effective on fires involving flammable liquids. Biological foam is a highly effective extinguishing foam that is primarily used to extinguish fires caused by fuels such as gasoline. It has excellent foam stability and resistance to re-ignition. It consists of a complex and proprietary blend of concentrate, fluorosurfactants, hydrocarbon surfactants, organic solvents, salts, polymers, pH buffers, biocides and corrosion inhibitors (Li et al., 2016:48-50). When foam is applied to the surface of a burning liquid fuel, it tends to accumulate accumulates on the fuel surface due to its lower density compared to the liquid fuel. The more foam is applied, the thicker it becomes and spreads over the fuel surface under the influence of gravity (Hinnat et al., 2017:653-655). It also has the ability to prevent the formation of fuel vapor. In addition, another function of the foam layer is to prevent re-ignition of the freshly extinguished fuel surface, even when the foam has degraded. This is achieved by the self-sealing property of the foam layer, which fills the void created after an impact (Ananth et al., 2019:4-6).

In recent years, the importance of effective disaster management and firefighting strategies has become increasingly apparent, especially in regions prone to natural disasters and emergencies. The Eastern Black Sea region of Turkey is one of the regions that are particularly prone to various disasters, including fires. In response, there are training programs at universities in the region that focus on civil defense and firefighting as well as emergency and disaster management. The effectiveness of these training programs in preparing students to deal with emergencies, including fires, is critical to improving overall disaster resilience in the region. An important aspect of firefighting is the knowledge and use of firefighting agents, such as biological

foam. The aim of this study is to determine the level of awareness of biological foam among students enrolled in civil defense and firefighting and emergency and disaster management programs at four universities in the Eastern Black Sea region. By assessing students' awareness of this type of firefighting, the study aims to help understand the preparedness of future emergency response teams in the region.

Determining the level of awareness in education is particularly important in order to recognize students' needs, provide more effective and targeted feedback to students, evaluate teaching methods and increase academic performance (Bıyıklı, et al., 2020:1-35). Teaching and learning methods include strategies, techniques and approaches used to make the educational process effective and efficient. These methods are selected and applied according to the learning needs, learning styles and teaching goals of the students. The instructional model can be explained as a philosophical perspective that is effective in determining strategies, methods and techniques. Models are used in designing the educational program, determining teaching materials and guiding instruction (Köksal and Atalay, 2015). Teaching models can be divided into two main types: individual teaching models and group teaching models. In this study, a new teaching methodology can be selected after determining the level of awareness.

The results of this research will provide valuable insight into the effectiveness of existing educational programs in that provide students with the necessary knowledge and skills to effectively deal with firefighting and emergencies. In addition, determining the level of awareness of firefighting tools such as biological foam among students will provide information for the development of curricula and training initiatives aimed at improving disaster preparedness and response in the region.

1. MATERIAL and METHODS

1.1. Research Design

This study, which aims to determine the level of knowledge of civil defense and firefighting and emergency and disaster management students regarding their knowledge of biological foam and to assess this level of knowledge as a function gender, grade level, and the degree program in which they are enrolled, was conducted using a quantitative general survey research design. The general survey model refers to research conducted on samples selected from the population or the population itself in order to draw conclusions about a broad population. This type of research is used to determine people’s tendencies, attitudes, characteristics and opinions on a particular issue (Gürbüz and Şahin, 2014:94-100). Therefore, the general survey model was

preferred in line with the scope of the research. This model is particularly useful for understanding the views of a broad sample on a particular issue and drawing conclusions.

1.2. Sample of the Research

A suitable sampling method was chosen for this study because it is easily accessible. A total of 260 students studying at four state universities in the Eastern Black Sea region participated in this research, whose data was collected in the 2022-2023 academic year. Participants were included in the study on the basis of voluntary participation.

The participants are students enrolled in the Civil Defence and Firefighting and Emergency and Disaster Management programmes at a total of 4 universities, namely Trabzon University, Artvin University, Giresun University and Gümüşhane University.

1.3. The Ethical Aspect of the Study

Approval was obtained from the Ethics Committee of the University of Trabzon before the study began. Before handing out the questionnaire, the students were informed about the purpose and content of the study and their voluntary participation was ensured. The data were collected from the students who were present in the school on the days when the questionnaire was distributed and who agreed to participate in the study.

1.4. Data Collection Tool

In the study, the 'Biological Foam Awareness Scale (BFAS)', which was developed in the form of a five-point Likert scale and is shown in Table 1, was used as a quantitative data collection instrument. The questionnaire included questions about the demographic characteristics of the students (age, gender, class) and their level of knowledge about fire and firefighting. In the last section, a scale was used to determine the level of knowledge about biological foam.

Table 1. Biological Foam Awareness Scale (BFAS)

	Please indicate your preference by placing an 'X' next to the statement that best represents your opinion. The statements correspond to the following options: **(5) Strongly agree, (4) Agree, (3) Somewhat agree, (2) Disagree, (1) Strongly disagree**.	**Strongly Disagree**	**Disagree**	**Somewhat Agree**	**Agree**	**Strongly Agree**
		1	**2**	**3**	**4**	**5**
	I have knowledge about how fires start.					
	I know how fires are classified.					
	I believe fires are largely human-caused.					
	I think fires always harm the environment.					
	I know the types of fire extinguishing agents.					
	I know which type of fire extinguishing agent to use according to the type of fire.					
	I know which extinguishing agents are harmful to the environment.					
	I know that all fire extinguishers are harmless to nature.					

	I know that foam is also used as a fire extinguishing agent.					
	I know that foam is a harmful fire extinguishing agent.					
	I think I have sufficient knowledge about the different types of extinguishing foam.					
	I know that biological foam is also used as an extinguishing agent.					
	I know which class of fires biological foam is used for.					
	I know which class of fires biological foam is not used for.					
	I know how biological foam is obtained.					
	I think biological foam can generate waste after use.					
	I know that biological foam is environmentally friendly.					
	I know that biological foam has advantages compared to other types of fire extinguishing agents.					
	I know where biological foam is used besides firefighting.					
	I know under what conditions biological foam is stored.					
	I think that using biological foam will completely extinguish the fire.					
	I know the types of fire extinguisher cylinders.					
	I know that biological foam is used in fire extinguisher cylinders.					
	I used a biological foam cylinder.					
	I know that biological foam cylinders are also used in vehicles.					
	I know that biological foam cylinders are used in electrical fires.					

The 'Biological Foam Awareness Scale' consisted of a total of 26 items, all of which were grouped under the "positive attitude" dimension. The Cronbach's alpha reliability coefficient reported by the researchers for the entire scale was calculated at .944. Considering the fact that the reliability coefficient for the reliability of the test should be above 0.70 (Büyüköztürk, 2018:179-182), it can be said that the test used is reliable.

1.5. Data Analysis

The data collected with the help of the questionnaire, consisting of five demographic questions in the first part, the participants' level of knowledge in the second part and the 26 items to measure the participants' level of awareness in the third part, were analyzed with the help of a computer-aided statistics program.

When analyzing the quantitative data collected using the scale, it was first determined whether the data followed a normal distribution that corresponded to research questions defined at the beginning of the study.

One of the methods for interpreting the normality of the data obtained is to use the values for skewness and kurtosis. In this method, the values for skewness and kurtosis are expected to be within a range of ±1.96 (Liu et al., 2005:293).

If the values are within this range, the data obtained are subjected to parametric analysis. The results of the analysis are shown in Table 2. When the results were examined, it was found that the skewness and kurtosis values of the data were within the range of -1.96 and +1.96,

indicating a normal distribution. Therefore, the T-test for independent samples, a parametric test, was used in the study.

Table 2. Skewness and Kurtosis Values of the Data

	Skewness	Kurtosis
Biology Foam Awareness Scale	-.186	-.396

As part of the study, descriptive analyses were carried out to determine the participants' level of awareness based on their responses on the scale used. When interpreting the calculated data, a value range of 0.80 was taken into account for the arithmetic mean. Accordingly, answers in the range of 1.00-1.79 were interpreted as 'strongly disagree', while values in the range of 4.20-5.00 were interpreted as 'strongly agree'. All values used to interpret the responses on the scale can be found in Table 3.

Table 3. Values Used in the Interpretation of the Arithmetic Mean of the Scale

Score Range	**Grading**	**Interpretation**
1.00 / 1.79	Strongly Disagree	Very Low
1.80 / 2.59	Disagree	Low
1.80 / 2.59	Neutral	Medium
3.40 / 4.19	Agree	High
4.20 / 5.00	Strongly Agree	Very High

2. RESULTS

This section presents the quantitative results of the study, which are interlinked. The classification of the results is based on the measurement instruments used. Only statistically significant results are considered in the comparisons with the quantitative data.

2.1. Participant Characteristics

This section examines the demographic characteristics of the current group participating in the study, such as gender, age, university, degree programme, and class. It also presents the participants' responses to the scale in detail.

The demographics of the participants in the study are listed in Table 4.

Table 4. Demographic Data

Variable	Categories	Number	Percentage (%)
Gender	Male	153	58.8
	Female	107	41.2
Age	17-20	167	64.2
	21-22	77	29.6
	23-24	12	4.6
	25 years and older	4	1.5
University	Trabzon University	91	35.0
	Gümüşhane University	57	21.9
	Giresun University	32	12.3
	Artvin University	80	30.8
Program	Emergency and Disaster Management Program	115	44.2
	Civil Defense and Firefighting Program	145	55.8
Class	1st Year	169	65.0
	2nd Year	91	35.0

Table 4 shows the introductory characteristics of the students participating in the study. An examination of the average age of the students shows that the majority of respondents, 64.2%, were between 17 and 20 years old, with the vast majority being male (58.8%). It was found that 35% of the respondents were in their second year of study, while 55.8% were enrolled in the Civil Defense and Firefighting program.

The answers given by the research participants in the context of the scale can be found in Table 5.

Table 5. Scale Questions Percentages

	1	2	3		4	5	Mean
I have knowledge about how fires start.	3.1	2.3	14.6		30.8	49.2	4.21
I know how fires are classified.	7.3	6.5	18.8		18.1	49.2	3.95
I believe fires are largely human-caused.	.8	5.4	21.9		33.5	38.5	4.03
I think fires always harm the environment.	4.2	3.8	14.2		14.6	63.1	4.28
I know the types of fire extinguishing agents.	7.3	10.8	18.5		22.3	41.2	3.79
I know which type of fire extinguishing agent to use according to the type of fire.	11.9	7.3	16.2		21.2	43.5	3.77
I know which extinguishing agents are harmful to the environment.	11.2	10.4	24.6		18.5	35.4	3.57
I know that all fire extinguishers are harmless to nature.	20.0	12.7	38.8		13.5	14.6	2.90
I know that foam is also used as a fire extinguishing agent.	5.8	3.1	7.3		10.4	73.1	4.42
I know that foam is a harmful fire extinguishing agent.	21.9	18.5	32.3		10.0	17.3	2.82
I think I have sufficient knowledge about the different types of extinguishing foam.	10.0	13.1	29.2		20.8	26.5	3.41
I know that biological foam is also used as an extinguishing agent.	13.1	11.9	29.2		20.0	25.0	3.32
I know which class of fires biological foam is used for.	20.8	13.5	26.2		18.5	21.2	3.06
I know which class of fires biological foam is not used	19.6	10.8	30.4		18.5	20.4	3.09

for.							
I know how biological foam is obtained.	26.2	15.8	25.0		14.6	18.5	2,83
I think biological foam can generate waste after use.	17.7	15.8	34.6		15.0	16.9	2.98
I know that biological foam is environmentally friendly.	18.8	17.3	33.5		16.2	13.8	2.89
I know that biological foam has advantages compared to other types of fire extinguishing agents.	16.5	14.6	34.2		19.6	15.0	3.02
I know where biological foam is used besides firefighting.	24.2	20.0	31.2		14.2	10.0	2.66
I know under what conditions biological foam is stored.	21.5	18.1	30.0		17.3	12.7	2.81
I think that using biological foam will completely extinguish the fire.	12.7	17.3	36.9		17.7	15.4	3.06
I know the types of fire extinguisher cylinders.	11.9	10.8	17.3		21.2	38.8	3.64
I know that biological foam is used in fire extinguisher cylinders.	19.2	12.3	31.5		16.5	20.0	3.06
I used a biological foam cylinder.	56.9	11.9	10.4		8.1	11.9	2.05
I know that biological foam cylinders are also used in vehicles.	23.1	13.8	26.9		15.8	20.0	2.96
I know that biological foam cylinders are used in electrical fires.	27.3	13.5	25.0		16.2	17.7	2.83

It seems that the point that the students participating in the investigation are most aware of is " I know that foam is also used as a fire extinguishing agent." (X:4.42). Another issue that the students seem to be aware of is: "I think that fires always harm the environment (X:4.28). In the context of the study, the issue that students seem to be least aware of is "I used a biological foam bottle." (X:2.05).

When analysing the participants' responses, 63.5% stated that they were aware of the types of extinguishing agents, 83.5% stated that the foam section is combined as an extinguishing agent, and 33.1% stated that the biological foam has the ability to completely extinguish the fire.

Table 6 shows the participants level of knowledge regarding fire, firefighting and drills. The majority of the students (85.8%) state that they had never been in contact with fire. In addition, most of them (80.8%) stated that they did not have a fire extinguisher at home. About half of the participants (53.8%) indicated that they had received fire extinguisher training before enrolling in school, and this rate increased to the highest level (84.6%) during their school years.

Table 6. Participants' Knowledge of Fire Extinguishers and Exercises

	1st Grade		**2nd Grade**		**Total**	
	Number	**%**	**Number**	**%**	**Number**	**%**
I have been exposed to any fire						
Yes	27	73.0	10	27.0	37	14.2
No	142	63.7	81	36.3	223	85.8
I have an emergency kit at home						

Yes	33	43.4	43	56.6	76	29.2
No	136	73.9	48	26.1	184	70.8
I have a fire extinguisher at home						
Yes	30	60.0	20	40.0	50	19.2
No	139	66.2	71	33.8	210	80.8
I believe the fire extinguishing materials in my area are sufficient.						
Yes	83	68.6	38	31.4	121	46.5
No	86	61.9	53	38.1	139	53.5
I have received fire extinguishing training before.						
Yes	64	45.7	76	54.3	140	53.8
No	105	87.5	15	12.5	120	46.2
I have used a fire extinguisher before.						
Yes	87	57.2	65	42.8	152	58.5
No	82	75.9	26	24.1	108	41.5
I have received training on fire extinguishing materials at school.						
Yes	131	59.5	89	40.5	220	84.6
No	38	95.0	2	5.0	40	15.4
I have participated in a fire extinguishing drill before.						
Yes	96	56.1	75	43.9	171	65.8
No	73	82.0	16	18.0	89	34.2

2.2. Results Regarding Students' Awareness of Biological Foam

This section of the study presents the results regarding the level of awareness of Biological Foam, which were analyzed using various variables.

To answer the first research question, "What is the level of awareness of biological foam among students in the Civil Protection and Firefighting and Emergency and Disaster Management programs?", an attempt was made to determine the level of awareness based on the students' responses to the scale used in the study. The values obtained from the analysis are listed in Table 7.

Table 7. Descriptive Statistics of the Participants' Level of Awareness

Items	**N**	**Ort.**	**ss**
Scale	260	3.28	0.834

The examination the statistical results in Table 7, shows that the level of awareness of the students is generally at a medium level ($\boldsymbol{x}$=3.28).

2.3. Findings on Awareness of Biological Foam among Students in Relation to the Gender Variable

Under this heading, an attempt was made to answer the research question posed in the study, 'Is awareness of biological foam changing in relation to the variable of gender? The numerical data from the analyses conducted to uncover this situation are presented in Table 8.

Table 8. T-test Results of the Biological Foam Awareness Scale by Gender

	Gender	N	X	Ss	sd	t	p
Biological Foam Awareness	Female	107	3.26	.85	258	-0.431	0.667
	Male	153	3.30	.82			

The independent samples t-test conducted to examine the differences in participants' awareness of biological foam according to gender revealed that there was no significant difference in participants' awareness of biological foam ($p > 0.05$).

2.4. Findings on Students' Awareness of Biological Foam in Relation to the Class Variable

In this section, the question of whether 'awareness of biological foam varies by grade level' was examined. The data on the results of the independent samples t-test conducted in this direction for independent samples are shown in Table 9.

Table 9. Independent Samples T-Test Results for the Biological Foam Awareness Scale Scores by Grade Level Variable

	Class	N	X	Ss	sd	t	p
Biological Foam Awareness	1st Grade	169	3.05	.82	258	-7.041	0.001
	2nd Grade	91	3.71	.65			

The independent-samples t-test conducted to determine the differences in participants' awareness of biological foam depending on the class variable (see Table 9) revealed a significant difference in participants' awareness of biological foam ($p < 0.05$). This significant difference between 1st and 2nd grade was found by examining the group means in the table, indicating that 2nd grade students were more aware ($X\_1st\ grade = 3.05$, $X\_2nd\ grade = 3.71$).

2.5. Results Regarding the Awareness of Biological Foam in Relation to the Variable of the Study Program Attended by the Participating Students

In this section, the question "Does the awareness of "biological foam differ depending on the level of the program attended?" was examined. The results of the t-test for independent samples carried out in this context are shown in Table 10.

Table 10. T-Test Results for Scores on the Biological Foam Awareness Scale by Level of Program Attended

		Program	**N**	**X**	**Ss**	**sd**	**t**	**p**
Biological Awareness	Foam	Emergency and Disaster Management Program	115	3.22	.85	258	-1.053	0.293
		Civil Defense and Firefighting Program	145	3.33	.81			

The results of the independent-samples t-test conducted to determine the differences in the participants' level of knowledge depending on the variable of the program in which they participated (see Table 10) show that there is no significant difference in the participants' level of knowledge regarding biological foam ($p > 0.05$).

2.6. The Results Regarding the Relationship Between Students' Knowledge of Fire and Awareness of Biological Foam

In this section the results concerning the relationship between students' knowledge of fire and knowledge of biological foam are presented. This section attempts to answer the question of whether participants' answers to the questions asked to determine their level of knowledge about fire influence their level of knowledge. The results of the independent samples t-test conducted for this purpose are presented in Table 11.

Table 11. Results of the Independent Samples T-Test for the Values of the Biological Foam Awareness Scale According to the Level of Knowledge about Fire

		Exposure to any fire	**N**	**X**	**Ss**	**sd**	**t**	**p**
Biological Awareness	Foam	Yes	37	3.56	.86	258	2.228	0.027
		No	223	3.24	.82			
		I have an emergency kit at home.	**N**	**X**	**Ss**	**sd**	**t**	**p**
Biological Awareness	Foam	Yes	76	3.49	.74	258	2.647	0.009
		No	184	3.20	.85			
		I have received fire extinguisher training before.	**N**	**X**	**Ss**	**sd**	**t**	**p**
		Yes	140	3.57	.72	258	6.391	0.001

Biological Awareness	Foam	No	120	2.95	.83			
		I have participated in fire extinguisher drills before.	**N**	**X**	**Ss**	**sd**	**t**	**p**
Biological Awareness	Foam	Yes	171	3.53	.75	258	7.205	0.001
		No	89	2.81	.77			

The T-test for independent samples, which was performed to determine the participants' level of knowledge about fire, revealed a significant difference in the level of knowledge about biological foam ($p<0.05$). When examining the variable of whether the participants had already experienced a fire, it was found that those who had already experienced a fire had a higher level of knowledge. When looking at the average responses of those who had already participated in fire drills, it was also found that those who had participated in the drills had a higher level of knowledge.

3. DISCUSSION

The results of our study show that second grade students have a significantly higher awareness of biological foam. This finding underscores the importance and necessity of including biosuds in educational programs. In a study by Doğan (2023:215-224), it was also emphasized that the activities of vocational training institutions are positive and necessary for the development of the profession. In particular, it was stated that study programs aimed at training in critical occupations such as firefighting are crucial for the development of the profession. In another study by Soyhan (2020:35-36) it is argued that the organization of the fire department must be continuously developed and that regular personnel training and similar activities are essential for this purpose.

In a study conducted by Zhang et al. (2022:6-8), a survey was conducted among 273 foreign and 144 domestic university students and a statistical analysis was used to determine the differences in fire safety knowledge, understanding and responses to fire extinguishers among the participants. The results of the survey, in which participants were divided into four groups according to gender and nationality, revealed significant differences in fire safety knowledge between gender and nationality. All groups had difficulty extinguishing the fire directly with fire extinguishers (Zhang et al., 2022:6-8). In our study, knowledge of biofoam did not differ by gender. However, it was found that knowledge about fires was higher among those who had participated in the exercise and those who had experienced a fire. Seçer and Sadyen (2006:50-51)

examined the level of fire safety knowledge of people of different age groups and its relationship to the level of fire safety education and how people of different age groups would react to a fire based on their fire safety education in order to estimate the extent to which fire safety education should be provided. Data from 158 participants aged 18 to 80 showed that fire safety education increases fire safety knowledge and fire response accuracy. The results also showed that middle-aged people responded more accurately to fires than younger and older adults (Seçer and Sadyen, 2006:50-51). In another study, based on the unexplored level of fire safety of citizens in Serbia, a quantitative survey on a model of fire safety behavior in residential buildings in Serbia was conducted in 2021, in which 540 people participated. The aim of the study was to determine to what extent the level of education and gender influence the prediction of the fire safety behavior model (individual readiness, personal safety, fire risk, fire safety knowledge) for residential buildings in Serbia. Multivariate regression analyzes showed that the most important determinant of individual preparedness, personal safety and perception of fire risk is gender, followed by age. In contrast, education level, property status and monthly income had no significant effect on individual preparedness for fire safety, personal safety, fire risk and knowledge of prevention (Cvetkovic et al., 2022:8-15). In this study, it was found that the level of awareness of biofoam among 2nd grade students was significantly higher than that of 1st grade students. In a study by Ishak et al. (2023:187-188), a cross-sectional study was conducted with 112 kindergarten teachers to assess the awareness and knowledge of fire safety among kindergarten teachers in Perak, Malaysia. Participants were recruited using a random sample and assessed using a self-administered questionnaire containing 37 questions. 90.2% of the participants had moderate knowledge of fire safety measures, while 70.5% had good awareness. It was found that preschool teachers paid significantly more attention to fire safety than teachers in private kindergartens (X^2=5.198, p=0.023). There was a significant relationship between education level and awareness of fire safety measures, suggesting that higher education level was associated with greater awareness (X^2=9.527, p=0.002) (Ishak et al., 2023:187-188). A study based on the Knowledge, Attitudes, and Practices Survey Model (KAP) theory examined the safety awareness of 12th grade STEM (science, technology, engineering, and mathematics) students on practices in public schools in the central Philippines before, during, and after the fire, according to gender and monthly family income. A valid and reliable questionnaire was administered to 94 randomly selected students using a descriptive, comparative and correlational approach. In general, it was found that the students had a clear awareness and were relatively good at pointing out the necessary precautions and responses to prevent and control the fire. In comparison, no significant difference was found when grouped by gender and monthly family income (Delaliarte et al. 2024:178-180).

Although topics such as fire safety or determining fire extinguishing awareness among different people are being studied in many countries around the world, the topic of biological foam is considered a new development in the field of firefighting. Therefore, it can be observed that both students and firefighters lack knowledge in this field. With the advancement of technology, it is necessary to know these new extinguishing agents in order to use them effectively. According to Doğan's (2023:278), the training of personnel in firefighting organizations is based on the municipal firefighting ordinance and is organized in annual, monthly and daily training plans. It was found that these plans also include current topics needed by the firefighting units. In a study by Dağhan (2021:66-70), it was emphasized that personnel need to be trained in order to minimize the number of casualties and losses caused by disasters and to carry out effective operations so that they can work more effectively in disasters. It was found that this training should be regularly supported by exercises and practical applications. Similarly, our study shows that exercises improve personal knowledge and operational skills and thus increase awareness in this regard.

CONCLUSION

This study examines the level of knowledge of students in the Civil Defense and Firefighting and Emergency and Disaster Management programs regarding the use of biological foams in firefighting. In the research conducted in the relevant faculties of four universities in the Eastern Black Sea region, as a result of the examination of the course curricula, it was determined that biological foam issues were addressed theoretically in the current courses, and it was concluded that the knowledge level of the participating students was insufficient. It is found that students' awareness varies depending on the year of study. However, no significant differences were found between the participants in terms of gender and program dimensions. Based on the results obtained in our study, the following recommendations have been proposed:

• College curricula for the relevant subject areas should include detailed content on the use and application of biological foam. Increased practical training on this topic can raise students' awareness.

• Firefighting teams should be informed about the use of biological foams. Education and awareness programs that highlight the benefits of using biological foams can facilitate their wider use.

• The use of biological foams in firefighting is an important step towards an environmentally friendly and sustainable approach to firefighting. Raising people's awareness of

these foams can lead to wider acceptance, reducing environmental impact and minimizing harm to human health.

Author Contributions

In this research article, Dönüş GENÇER contributed to research design, data collection, data analysis, article writing, Lokman ODABAŞ contributed to data analysis and article writing, and Recep KİRİŞ contributed to research design and data collection.

Conflict of Interest

There is no conflict of interest to declare

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